PATENT ABSTRACTS OF JAPAN

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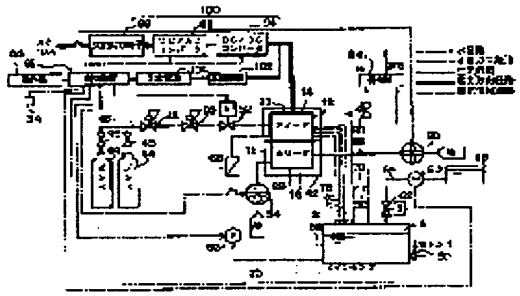
(54) FUEL CELL APPARATUS

(57)Abstract:
PROBLEM TO BE SOLVED: To avoid freezing of water that circulates inside a solid polymer fuel cell, even if it is installed in a low-temperature environment.
SOLUTION: A control device 92 sets a freeze proofing mode by an operation mode switching signal from a control panel 33. When setting the freeze proofing mode, if the ambient temperature of the apparatus is identified as being a fixed threshold or lower according to a detected signal from a temperature sensor 34, the control device 92 causes a fuel cell 42 to generate a quantity of heat corresponding to the ambient temperature through the control drive and stopping of the fuel cell 42. The heat generated from the fuel cell 42 moves to circulation water and heat up the water, which circulates between the fuel cell 42 and a main water tank 56 using a pump 66. Thereby, the freezing of the circulation water is presented by keeping it at a temperature higher than the freezing point, even if the ambient temperature of the apparatus is 0°C or lower.



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* NOTICES *

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CLAIMS

[Claim(s)]
[Claim 1] The solid-state macromolecule form fuel cell which the hydrogen in fuel gas is made to react to the radical of mediation of water with the oxygen in air, and generates heat and electrical energy, Anti-freeze mode can be set up as a water cycle means to connect with the water supply section and the wastewater section of said body of a solid-state macromolecule form fuel cell, and to make a solid-state macromolecule form fuel cell circulate through water, a temperature detection means to detect the temperature of the equipment exterior, and operation mode of equipment. And so that the water through which it circulates with said water cycle means may be maintained by the elevated temperature from the freezing point, if the detection temperature of said temperature detection means is lower than a predetermined threshold at the time of a setup in said anti-freeze mode Fuel cell equipment characterized by having the control means which controls the calorific value from said body of a solid-state macromolecule form fuel cell.
[Claim 2] Said control means is fuel cell equipment according to claim 1 characterized by making it correspond to said detection temperature, and changing the calorific value from said solid-state macromolecule form fuel cell, when the detection temperature of said temperature detection means is lower than said threshold at the time of a setup in said anti-freeze mode.
[Claim 3] Fuel cell equipment according to claim 1 or 2 characterized by having an information means to report that the detection temperature of said temperature detection means is lower than said threshold at the time of a setup in said anti-freeze mode.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to fuel cell equipment equipped with the solid-state macromolecule form fuel cell which the hydrogen in fuel gas is made to react to the radical of mediation of water with the oxygen in air, and generates electrical energy.
[0002]
[Description of the Prior Art] Since it becomes possible to generate power by supply of fuel gas, fuel cell equipment does not need the charge before the beginning of using as compared with a battery. The increment in need will be predicted by such advantage from now on as a power source for an outdoor type or emergencies in fuel cell equipment.
[0003] The configuration of the solid-state macromolecule form fuel cell used for fuel cell equipment is shown in drawing 4 . The anode side air space 14 which uses the electrode zygote 12 as a septum, and the cathode side air space 16 are formed in the interior of the solid-state macromolecule form fuel cell (henceforth a fuel cell) 10. As the electrode zygote 12 is shown in drawing 4 , an anode 20 is formed on one Men of an electrolyte membrane 18, and the cathode 22 is formed on Men of another side, respectively. An anode 20 and a cathode 22 are constituted by the catalyst electrode 24 which consists of platinum etc., respectively, and the charge collector 26 by which the laminating was carried out on this catalyst electrode 24, and these anodes 20 and cathodes 22 are connected to the external circuit 28. Here, as an electrolyte membrane 18, macromolecule ion exchange membrane (for example, fluororesin system ion exchange membrane which has a sulfonic group) is used.
[0004] While the hydrogen gas of a high grade is supplied to the anode side air space 14 of the fuel cell 10 constituted as mentioned above as fuel gas from a bomb, a reforming machine (illustration abbreviation), etc., water is supplied to it with a pump etc., and air is supplied to the cathode side air space 16 by the fan etc. The hydrogen supplied to the anode side air space 14 is ionized on an anode 20, and this hydrogen ion sets the inside of an electrolyte membrane 18 to H+ and xH2 O with a water molecule, and moves to a cathode 22 side. The hydrogen ion which moved to this cathode 22 reacts with the electron which has flowed the oxygen and the external circuit 24 in air, and generates water. Since an electron flows an external circuit 28 with the generation reaction of this water, it becomes possible to use the flow of this electron as electrical energy of a direct current.
[0005] Here, in order for a hydrogen ion to flow the interior of an electrolyte membrane 18 smoothly by little resistance, it is necessary to maintain an electrolyte membrane 18 at the condition of having carried out humidity. On the other hand, a fuel cell 10 cannot transform all chemical energy of the supplied hydrogen gas into electrical energy, but a part of chemical energy is changed into heat. For this reason, in order to maintain the internal temperature of a fuel cell 10 below at the allowable temperature which heat damage does not generate, it is necessary to discharge heat from the inside of a fuel cell 10 at the time of the drive of a fuel cell 10. So, while supplying water and maintaining an electrolyte membrane 18 at a damp or wet condition with hydrogen gas, water cooling of the fuel cell 10 is carried out to the anode side air space 14 of a fuel cell 10. A part serves as a steam and the water supplied in the fuel cell 10 is discharged out of a fuel cell 10 with unreacted hydrogen gas and air, with the water with which the remainder was generated on the cathode 22, is brought together in the fuel cell 10 lower part, and is discharged outside.
[0006] The water discharged from the fuel cell is once stored in a flush tank, and there is a thing equipped with the hydrologic cycle path supplied to a fuel cell from a flush tank with a pump at the time of the drive of a fuel cell in fuel cell equipment equipped with the above fuel cells.
[0007]

[Problem(s) to be Solved by the Invention] However, when fuel cell equipment equipped with the hydrologic cycle path is installed in the bottom of low-temperature environments, such as the outdoors of a cold district, if it does not operate beyond fixed time amount, the water within a fuel cell and a circulation path will be frozen, it becomes operation impossible or there is a possibility that equipment may be damaged by the swelling pressure at the time of water being frozen.
[0008] In consideration of the above-mentioned fact, the purpose of this invention is to offer the fuel cell equipment by which freezing of the water which circulates through a solid-state macromolecule form fuel cell is prevented, even when installed in the bottom of a low-temperature environment.
[0009]
[Means for Solving the Problem] The solid-state macromolecule form fuel cell which fuel cell equipment according to claim 1 makes the hydrogen in fuel gas react to the radical of mediation of water with the oxygen in air, and generates heat and electrical energy, Anti-freeze mode can be set up as a water cycle means to connect with the water supply section and the wastewater section of said solid-state macromolecule form fuel cell, and to make a solid-state macromolecule form fuel cell circulate through water, a temperature detection means to detect the temperature of the equipment exterior, and operation mode of equipment. And when the detection temperature of said temperature detection means is lower than a predetermined threshold at the time of a setup in said anti-freeze mode, it has the control means which controls the calorific value from said solid-state macromolecule form fuel cell so that the water through which it circulates with said water cycle means may be maintained by the elevated temperature from the freezing point.
[0010] According to the fuel cell equipment of the above-mentioned configuration, when a control means sets up anti-freeze mode, when the temperature of the equipment exterior is lower than a predetermined threshold, the calorific value from a solid-state macromolecule form fuel cell is controlled, and the water which circulates through a solid-state macromolecule form fuel cell as a part of circulation path is maintained from the freezing point to an elevated temperature with the heat supplied from the solid-state macromolecule form fuel cell. Therefore, by setting up anti-freeze mode, even when equipment is installed in the bottom of a low-temperature environment, freezing of the water which circulates through a solid-state macromolecule form fuel cell is prevented.
[0011] Here, a control means controls the heating value which a solid-state macromolecule form fuel cell generates by changing the ratio of drive time amount and a stop time in the run cycle which repeats a drive/halt of a solid-state macromolecule form fuel cell, or changing the load to a solid-state macromolecule form fuel cell, when the detection temperature of a temperature detection means is lower than a predetermined threshold at the time of a setup in anti-freeze mode.
[0012] In fuel cell equipment according to claim 1, if said control means has the detection temperature of said temperature detection means lower than said threshold at the time of a setup in said anti-freeze mode, fuel cell equipment according to claim 2 will be made to correspond to said detection temperature, and will change the calorific value from said solid-state macromolecule form fuel cell.
[0013] According to the fuel cell equipment of the above-mentioned configuration, freezing of the water which circulates through a solid-state macromolecule form fuel cell at the time of a setup in anti-freeze mode is prevented certainly, and the calorific value from a solid-state macromolecule form fuel cell can be controlled to a proper value not to make circulating water of a parenthesis into an elevated temperature beyond the need.
[0014] Fuel cell equipment according to claim 3 has an information means to report that the detection temperature of said temperature detection means is lower than said threshold at the time of a setup in said anti-freeze mode, in fuel cell equipment according to claim 1 or 2.
[0015] According to the fuel cell equipment of the above-mentioned configuration, since anti-freeze mode is set up as operation mode of equipment and freezing of circulating water is prevented, an operator can recognize easily that the calorific value from a solid-state macromolecule form fuel cell is controlled.
[0016]
[Embodiment of the Invention] Hereafter, the operation gestalt of this invention is explained with reference to a drawing.
[0017] (Configuration of an operation gestalt) The fuel cell equipment concerning the operation gestalt of this invention is shown in drawing 3 from drawing 1 . In addition, since the fuel cell 10 and fundamental configuration which were explained based on drawing 3 are common, the fuel cell shown in drawing 2 and drawing 3 attaches the same sign about a corresponding member, and omits the configuration and the detailed explanation about actuation.

[0018] Fuel cell equipment 30 is equipped with the exterior chassis object 32 formed in the abbreviation rectangular parallelepiped as shown in drawing 1 . While the door 36 supported possible [the temperature sensor 34 for detecting the temperature of a control panel 33 and the equipment exterior and closing motion] is arranged, the exhaust air section 38 is formed in one side face of this exterior chassis object 32 under the control panel 33. Starting / earth-switch 33A, operation mode setup-key 33B, and operation display lamp 33C are prepared in the control panel 33. Here, the door 36 is arranged at inlet-port opening of the bomb receipt room (illustration abbreviation) established in the interior of the exterior chassis object 32, and the vent hole of a large number which were open for free passage to the jet pipe (illustration abbreviation) of the exterior chassis object 32 is formed in the exhaust air section 38. Moreover, the axle-pin rake 40 is stationed on the inferior surface of tongue of the exterior chassis object 32 at each corner section, respectively, and migration of fuel cell equipment 30 is made easy by these axle-pin rakes 40.
[0019] In the exterior chassis object 32, while various kinds of members concerning power generating of fuel cell 42 grade shown in drawing 2 are arranged, the bomb 44 with which it filled up with high-pressure hydrogen gas is contained exchangeable. A maximum of two of this bomb 44 can be contained in the bomb receipt room within the exterior chassis object 32, and it becomes exchangeable by opening a door 36.
[0020] As shown in drawing 2 , the bomb 44 is equipped with the hand valve 45, and this hand valve 45 is connected with the anode side air space 14 of a fuel cell 42 by the hydrogen supply pipe 46. The closing motion valve 52 is arranged. the hydrogen supply pipe 46 -- the piping middle -- regulators 48 and 50 and electromagnetism -- the 1st step of regulator 48 The high-pressure (1 - 150 Kgf/mU) hydrogen gas supplied from the bomb 44 through the hand valve 45 made into the open condition is decompressed to 1 - 2 Kgf/mU extent. The 2nd step of regulator 50 decompresses the hydrogen gas decompressed by the 1st step of regulator 48 to 0.05 Kgf/mU extent. electromagnetism -- the closing motion valve 52 will be in an open condition at the time of impression of driver voltage (at the time of ON), and will be in a closed state at the time (at the time of OFF) of un-impressing [of driver voltage]. therefore, electromagnetism -- at the time of impression of the driver voltage to the closing motion valve 52, the hydrogen gas decompressed by regulators 48 and 50 supplies the anode side air space 14 -- having -- electromagnetism -- at the time of un-impressing [of the driver voltage to the closing motion valve 52], supply of the hydrogen gas to the anode side air space 14 is intercepted. On the other hand, air is supplied to the cathode side air space 16 by the fan (sirocco fan) 54.
[0021] the Maine tank 56 for supplying water to the anode side air space 14 of a fuel cell 42 in the exterior chassis object 32, as shown in drawing 3 , and the subtank 58 for supplementing this Maine tank 56 with pure water arrange -- having -- **** -- the Maine tank 56 and the subtank 58 -- a pump 60 and electromagnetism -- it is connected by the feed pipe 64 by which the closing motion valve 62 has been arranged. the pure water with which the subtank 58 was supplied from the equipment outside here -- storing -- **** -- a pump 60 -- driving -- and electromagnetism -- if the closing motion valve 62 becomes open, the pure water in the subtank 58 will be supplied to the Maine tank 56.
[0022] The Maine tank 56 is connected with the fuel cell 42 by the feed pipe 70 by which the pump 66 and the filter 68 have been arranged. As shown in this fuel cell 42 at drawing 3 , four joint tubing 72 for water supply is arranged in the upper part, and four joint tubing 74 for wastewater is arranged at the lower part. The drainage ditch (illustration abbreviation) which discharges the water generated with the water and the cathode 22 which were not consumed by the supply channel (illustration abbreviation) which supplies the water supplied from the joint tubing 72 for water supply to the anode side air space 14, and the anode side air space 14 from the joint tubing 74 for wastewater is established in the interior of a fuel cell 42. The feed pipe 70 which branched into four on the lower stream of a river of a filter 68 is connected to four joint tubing 72 for water supply, respectively. Moreover, as shown in drawing 3 , the drain pipe 76 is connected to four joint tubing 74 for wastewater, respectively, and the water discharged from the joint tubing 74 for wastewater is collected in the Maine tank 56 through a drain pipe 76. Therefore, the water currently stored in the Maine tank 56 circulates through a feed pipe 70, a fuel cell 42, and a drain pipe 76 by driving a pump 66.
[0023] By supplying the air in which hydrogen gas and water contained the oxygen which is supplied to the anode side air space 14, and which is both reactant gas to the cathode side air space 16, it generates the electrical energy of a direct current while a fuel cell 42 ionizes the hydrogen of the amount according to a power load on an anode 20, makes this hydrogen ion react with the electron which has flowed the oxygen and the external circuit in air on a cathode 22 and generates water.
[0024] As shown in drawing 2 , the anode side air space 14 is connected with the Maine tank 56 by the gas exhaust pipe 78, and the Maine tank 56 is connected with the mixer 84 by the gas exhaust pipe 82 by which

the needle valve 80 has been arranged.
[0025] It flows into the up space (gaseous layer A) of circulating water which impure gas (these are hereafter called unconverted gas), such as hydrogen gas which did not react on the anode 20 and nitrogen, and carbon dioxide gas, can be collecting in the Maine tank 56 through the gas exhaust pipe 78 from the anode side air space 14. Within the Maine tank 56, moisture is removed from the unconverted gas which flowed from the anode side air space 14, and this unconverted gas flows into a mixer 84 through the gas exhaust pipe 82. Here, the needle valve 80 is beforehand adjusted so that it may become whenever [predetermined valve-opening], and in order to prevent that impure gas condenses within the anode side air space 14, a little unconverted gas is discharged from the anode side air space 14 at the time of the drive of a fuel cell 42.
[0026] On the other hand, the cathode side air space 16 is connected with a mixer 84 by the air exhaust pipe 86, and a fan's (sirocco fan) 88 airpipe is connected in the middle of piping of this air exhaust pipe 86. Therefore, the unconverted gas from the anode side air space 14, the cathode side air space 16, and the air from a fan 88 flow into a mixer 84. In order that a mixer 84 may mix the unconverted gas and air containing hydrogen gas and may prevent hydrogen explosion, it dilutes a unconverted gas with air and emits it to a jet pipe so that hydrogen concentration may become below 0.01 volume %. The exhaust gas emitted to this jet pipe is discharged from the exhaust air section 38 of the exterior chassis object 32 in the equipment exterior.

[0027] At the time of the drive of a fuel cell 42, the water which moved to the cathode side air space 16 from the anode side air space 14 is discharged with air to a mixer 84, and since moisture remains slightly also in the unconverted gas which flowed into the mixer 84 from the Maine tank 56 further, circulating water in the Maine tank 56 decreases in number with the increment in the drive time amount of a fuel cell 42. the Maine tank 56 -- water level -- a sensor 90 arranges -- having -- **** -- this water level -- if a sensor 90 falls to water level predetermined in circulating water in the Maine tank 56 -- water level -- a detecting signal is outputted to a control unit 92.
[0028] water level -- the water level from a sensor 90 -- the control unit 92 which received the detecting signal -- the electromagnetism of a feed pipe 64 -- at the same time it makes the closing motion valve 62 open -- a pump 60 -- driving -- the pure water in the subtank 58 -- the Maine tank 56 -- supplying -- after progress of predetermined time -- electromagnetism -- a pump 60 is suspended at the same time it makes the closing motion valve 62 close. Under the present circumstances, a control unit 92 supplements the Maine tank 56 with the amount of water set up so that a gaseous layer A might surely remain on circulating water in the Maine tank 56. moreover, electromagnetism -- the back flow of the water from the Maine tank 56 to the subtank 58 which became high pressure from the atmospheric pressure by the unconverted gas is prevented by performing a drive/halt of open/close one of the closing motion valve 62, and a pump 62 to coincidence.
[0029] Moreover, as shown in drawing 2 , the current supply circuit 100 which consists of DC to DC converter 94, a DC/AC inverter 96, and an alternating current output terminal 98 is connected to a fuel cell 42, and the charge circuit 102 is connected to it so that it may become parallel to this current supply circuit 100. This charge circuit 102 is connected to the rechargeable battery 104 which supplies a power source to the electric equipment article of equipment through the control unit 92.
[0030] (Operation of an operation gestalt) The actuation and the operation of fuel cell equipment 30 of this operation gestalt which were constituted as mentioned above are explained hereafter.
[0031] A control panel 33 will output a stop signal to a control device 92, if starting / earth-switch 33A is pushed in the condition that will output a seizing signal to a control device 92 if starting / earth-switch 33A is pushed in the condition that equipment is carrying out shutdown, and equipment is operated.
[0032] A control unit 92 will start operation of equipment by the usual operation mode whose current supply to an external device becomes possible, if the seizing signal from a control panel 33 is received. this -- usually -- the time of operation by operation mode -- a control unit 92 -- the electromagnetism of the hydrogen supply pipe 46 -- the closing motion valve 52 is made open, hydrogen gas is supplied to a fuel cell 42, and while making it synchronize with supply initiation of this hydrogen gas and driving a pump 66, a fan 54, and a fan 88, DC to DC converter 94 and the DC/AC inverter 96 are driven. Thereby, after the direct current power which the fuel cell 42 generated is changed into an electrical potential difference predetermined with DC to DC converter 94, it is changed into an alternating current from a direct current with the DC/AC inverter 96, and is sent to the alternating current output terminal 98. And a fuel cell 42 generates the alternating current according to the power consumption of the external device (illustration abbreviation) connected to the alternating current output terminal 98. Here, the fuel cell equipment 30 of this

operation gestalt is constituted as a self-conclusion type whose electric power supply from the outside is unnecessary. For this reason, a charge circuit 102 charges a rechargeable battery 100 with the dump power of a fuel cell 42, and always stores the power which is needed at the time of starting in the rechargeable battery 104.

[0033] if a control unit 92 usually receives the stop signal from a control panel 33 at the time of equipment operation by operation mode -- the electromagnetism of the hydrogen supply pipe 46 -- while the closing motion valve 52 is made close and suspending supply of the hydrogen gas to a fuel cell 42, making it synchronize with the supply interruption of this hydrogen gas and stopping a pump 66, a fan 54, and a fan 88, operation of equipment is suspended by suspending DC to DC converter 94 and the DC/AC inverter 96. Moreover, a control panel 33 will output an operation change signal, if operation mode setup-key 33B is usually pushed at the time of equipment operation by operation mode, and the control unit 92 which received this operation change signal usually changes the operation mode of equipment from operation mode to anti-freeze mode.

[0034] The control routine of the control device 92 when anti-freeze mode is set up as operation mode of equipment in the fuel cell equipment 30 of this operation gestalt is explained with reference to drawing 5 . In addition, the control unit 92 of this operation gestalt contains the internal timer and memory which omitted illustration. The data table which the RISE@TTO time amount which specifies the control period in anti-freeze mode is beforehand set to this internal timer, and memorized the control condition of the equipment in anti-freeze mode in memory is prepared.

[0035] if anti-freeze mode is set up as operation mode of equipment in response to the operation change signal from a control panel 33 at step 202 of drawing 5 -- step 204 -- the electromagnetism of the hydrogen supply pipe 46 -- while making the closing motion valve 52 close, a pump 66, a fan 54, and a fan 88 are stopped, a drive halt of the fuel cell 42 is carried out, and DC to DC converter 94 and the DC/AC inverter 96 are suspended further.

[0036] While starting a time check by the internal timer at steps 206-208, the external atmospheric temperature which stored temporarily the temperature (external atmospheric temperature) of the equipment exterior obtained by the detecting signal from a temperature sensor 34, and was stored temporarily at step 210 judges [below a predetermined threshold (for example, 5 degreeC) and] whether it is higher than a threshold. the case where the outside temperature carried out at step 210, and it is judged below as a threshold -- steps 212-214 -- the electromagnetism of the hydrogen supply pipe 46 -- the drive time amount corresponding to the external atmospheric temperature detected by the temperature sensor 34 is read from the data table of memory, and this drive time amount is set to an internal timer at the same time it makes a pump 66, a fan 54, and a fan 88 drive and drives a fuel cell 42, while making the closing motion valve 52 open. Thereby, the drive time amount corresponding to external atmospheric temperature and the reset time set up beforehand are set to an internal timer. Here, drive time amount is the range shorter than the reset time beforehand set as the internal timer, and it is set up so that it may become long, as external atmospheric temperature turns into low temperature. an internal timer -- first -- a time check -- if the elapsed time from initiation is in agreement with drive time amount, the drive time amount set will be reset -- both drive terminate signals are outputted.

[0037] if the input of a drive terminate signal is judged at step 216 -- step 218 -- the electromagnetism of the hydrogen supply pipe 46 -- while making the closing motion valve 52 close, a pump 66 and fans 54 and 88 are stopped and a drive halt of the fuel cell 42 is carried out. an internal timer -- after the output of a drive terminate signal -- a time check -- continuing -- a time check -- if the elapsed time from initiation turns into a reset time -- a time check -- while resetting time amount to 0, a reset signal is outputted to a control unit 92.

[0038] if the input of a reset signal is judged at step 220 -- step 222 -- the time check of an internal timer -- it judges whether it is the no which starting / earth-switch 33A was pushed on from initiation before a reset time, and the stop signal inputted from the control panel 33. When the input of a stop signal is judged at step 222, operation of the equipment in anti-freeze mode is suspended, and when it is judged that the stop signal has not inputted at step 222, a return is carried out to step 206, and the control routine from step 206 is performed again.

[0039] moreover, the step 226 when external atmospheric temperature is judged to be higher than a threshold at step 210, after judging the input of the reset signal from the internal timer which clocked the reset time at step 224 -- the time check of an internal timer -- it judges whether it is the no which starting / earth-switch 33A was pushed on from initiation before a reset time, and the stop signal inputted from the control panel 33. When it is judged that the stop signal has not inputted after the input of a reset signal at

step 226, a return is carried out to step 206 and the control routine from step 206 is performed again. Moreover, when what the stop signal inputted after the input of a reset signal at step 226 is judged, operation of the equipment in anti-freeze mode is suspended.

[0040] As mentioned above, according to the control at the time of a setup in the anti-freeze mode explained based on drawing 5 , a fuel cell 42 drives that the temperature of the equipment exterior is below a predetermined threshold, and heat is generated. A part of generating heat from this fuel cell 42 moves to circulating water which circulates through the inside of a fuel cell 42, and it heats circulating water. Thereby, even if the atmospheric temperature of the equipment exterior is below the freezing point (for example, 0-degreeC), the water which circulates through between the Maine tank 56 and fuel cells 42 is maintained from the freezing point to an elevated temperature, and freezing can be prevented. Under the present circumstances, in the run cycle which repeats a drive/halt of a fuel cell 42, since the calorific value from a fuel cell 42 can be controlled to a proper value not to consider as an elevated temperature beyond the need, without freezing circulating water even when external atmospheric temperature changes with time by lengthening drive time amount and enlarging calorific value per time amount from a fuel cell 42 so that external atmospheric temperature is low, the consumption of hydrogen gas can be saved, using hydrogen gas efficiently.

[0041] Moreover, a control unit 92 is continued until it outputs an alarm signal to a control panel 33, and the stop signal from a control panel 33 inputs the output of this alarm signal or external atmospheric temperature is judged to be higher than a predetermined threshold, when it is judged at the time of a setup in anti-freeze mode that external atmospheric temperature is below a predetermined threshold. A control panel 33 blinks operation display lamp 33C with a predetermined period during the input of an alarm signal. Since anti-freeze mode is set up as operation mode of equipment by operation display lamp 33C which is blinking and an operator prevents freezing of circulating water, he can recognize easily that automatic control of a drive/the halt of a fuel cell 42 is carried out, and the hydrogen gas of a bomb 44 is consumed for the anti-freeze of circulating water.

[0042] Moreover, although only the case where made it correspond to external atmospheric temperature, changed drive time amount in the run cycle which repeats a drive/halt of a fuel cell 42, and the calorific value per time amount from a fuel cell 42 was controlled by the control routine explained based on drawing 5 was explained, it is also possible to make it correspond to external atmospheric temperature, to change the load to a fuel cell 42, and to control the calorific value per time amount. In this case, it becomes possible by controlling a charge circuit 102 and, for example, changing the charge rate to a rechargeable battery 104 to change the load to a fuel cell 42.

[0043] Moreover, the coolant temperature sensor which measures the water temperature of circulating water in the Maine tank 56 is formed, and when external atmospheric temperature lower than a value is detected in predetermined one and the automatic control of a fuel cell 42 is started at the time of a setup in anti-freeze mode, feedback control of the calorific value from a fuel cell 42 may be carried out so that circulating water may not be frozen by the detecting signal from a coolant temperature sensor.

[0044] Although explanation concerning this above-mentioned operation gestalt indicated only the configuration and control for carrying out anti-freeze of the water which circulates through between a fuel cell 42 and the Maine tanks 56 at the time of a setup in anti-freeze mode If exoergic means, such as a halogen heater, are installed in the subtank 58 and this exoergic means is made to generate heat at the time of a setup in anti-freeze mode, when fuel cell equipment 30 is installed in the bottom of a low-temperature environment, prevention also of the pure water in the subtank 58 also being frozen will be attained.

[0045]

[Effect of the Invention] As explained above, even when equipment is installed in the bottom of a low-temperature environment, according to the fuel cell equipment of this invention, freezing of the water which circulates through a solid-state macromolecule form fuel cell is prevented certainly.

[Translation done.]

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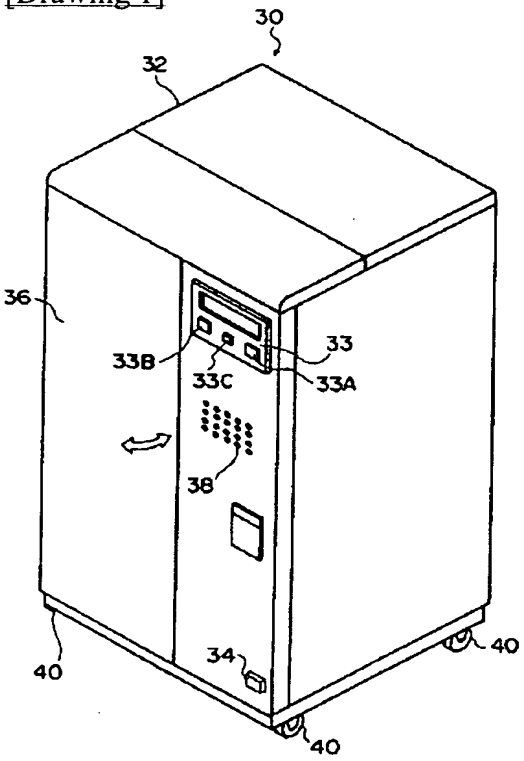
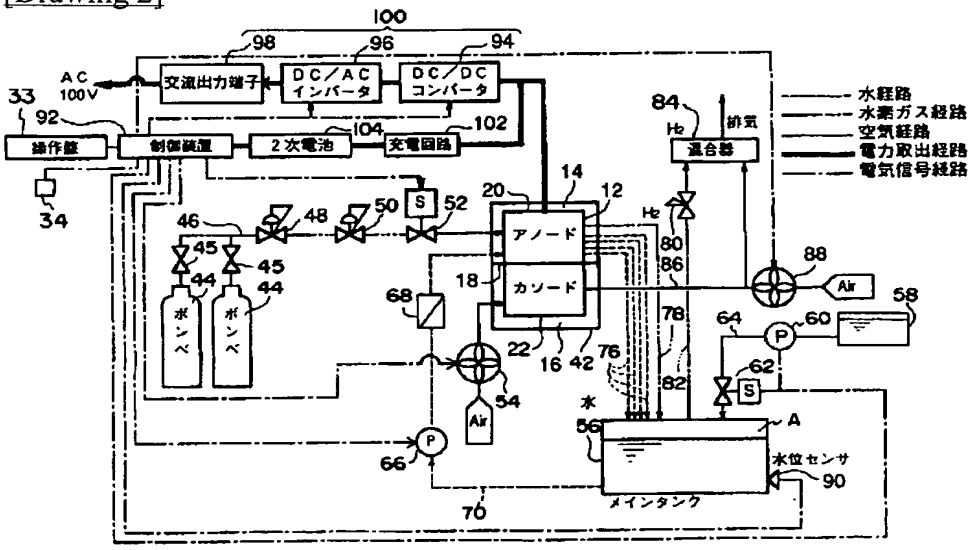
DRAWINGS

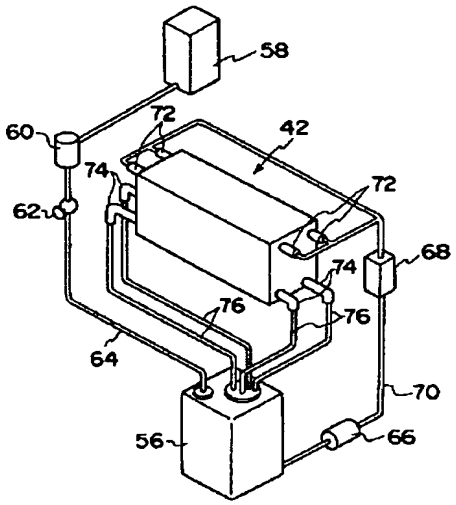
[Drawing 1]



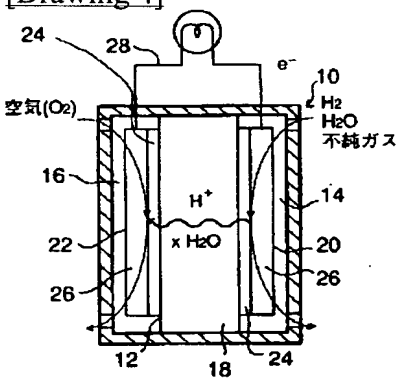
[Drawing 2]



[Drawing 3]

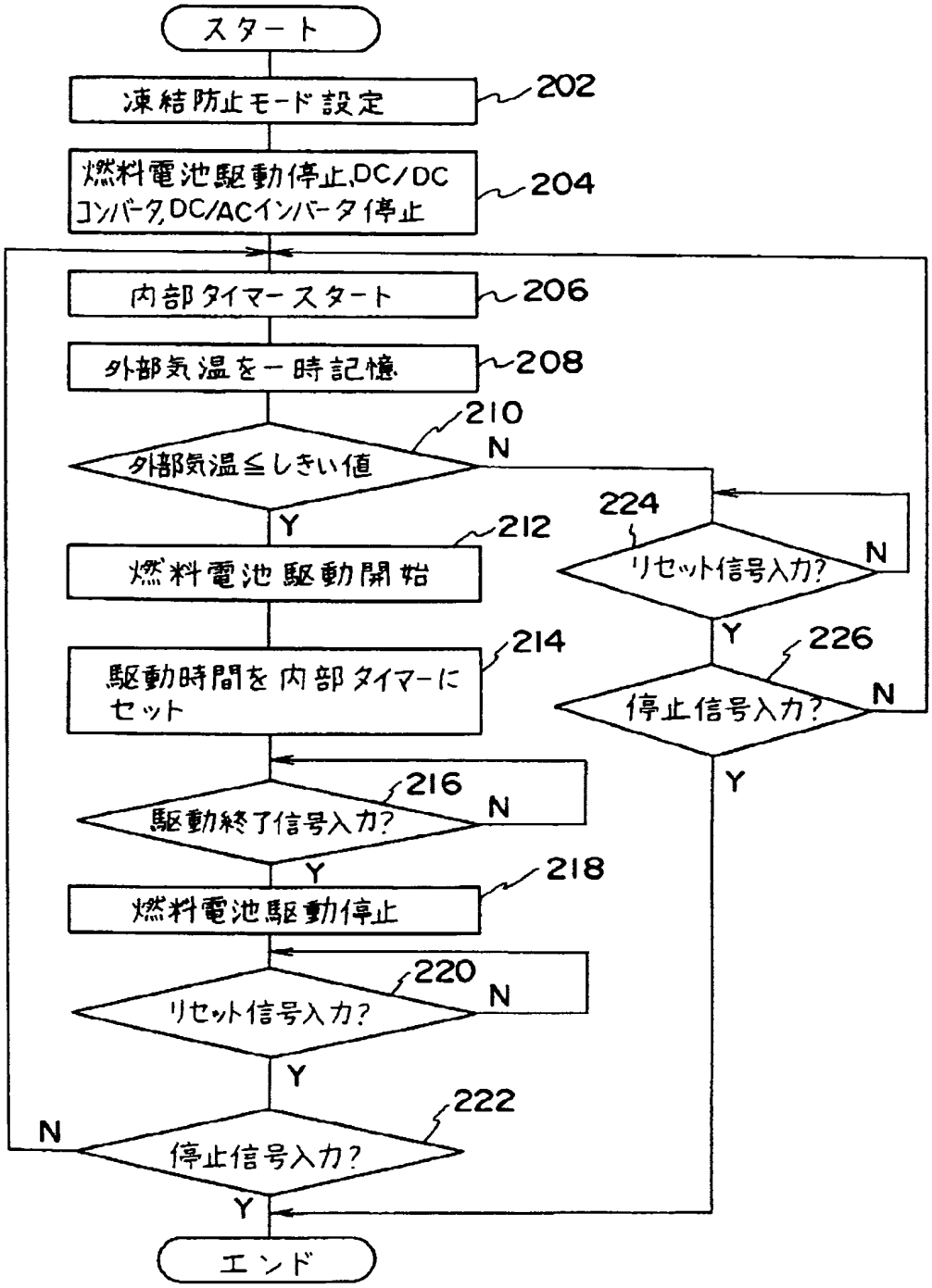


[Drawing 4]



アノード側	$H_2 \rightarrow 2H^+ + 2e^-$
カソード側	$1/2\ O_2 + 2H^+ + 2e^- \rightarrow H_2O$
全反応	$H_2 + 1/2\ O_2 \rightarrow H_2O$

[Drawing 5]



[Translation done.]